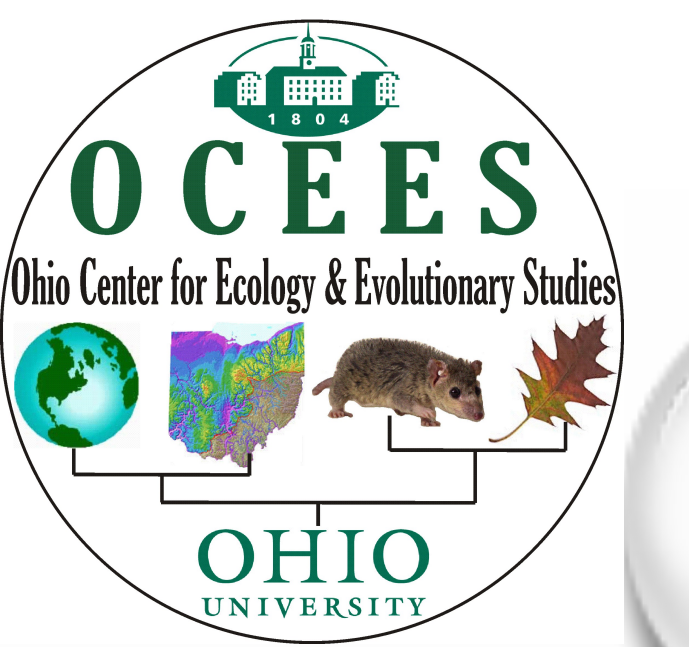


BEHAVIORAL FEATURES USED TO IDENTIFY INVASIVE POTENTIAL IN THE GREEN SWORDTAIL FISH, *XIPHOPHORUS HELLERI*



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Introduction

- A behavioral syndrome (bold-aggressive) was previously detected in a species of swordtail fish, *Xiphophorus multilineatus* (1).
- Life history traits of invasive species have been well studied but not behavioral syndromes.
- An “invasion syndrome” is a behavioral syndrome that could explain the success of an invasive population (2).
- *X. helleri* are invasive freshwater fish found worldwide (3).

Questions

1) Are the measures of exploration, aggression, and boldness repeatable? 2) Is there a behavioural syndrome in the native population? 3) Is there a behavioural syndrome in the invasive population, and is it different from the native population?

Methods

- Fish were captured from Veracruz, Mexico & Kauai, Hawaii and were kept in individual tanks for identification.
- Tests were conducted in the following order: exploration, aggression, and boldness, with at least 2h and no more than 24 h between tests. Each test was 300s in length.
- All three behavioral tests were repeated after 48h+.
- **Exploration test:** conducted in a 30g tank divided into 10 segments, measuring latency to move, number of movements, movement to new area, and areas used were counted.
- **Aggression test:** conducted in the home tank, measuring latency to approach, approaches, and bites at a mirror.
- **Boldness test:** conducted in the home tank. Fish were fed a novel food item. Once feeding, they were “attacked” by a net. Time to feed, time to re-emerge after attack, and time to resume feeding were measured.
- Data analyses were conducted in R. Measures were analyzed with NMDS plot (metaMDS; vegan) (Fig. 1) to chose associated behaviors. Repeatability was calculated by finding the best fit linear mixed effect model and calculating an interclass coefficient (lme; nlme package). Finally, association between behaviors was investigated with generalized linear models (glm; nlme).

Results

Question 1) Measures differed in repeatability (Table 1).

Question 2) Yes, a correlation was detected between all three behaviors. **Question 3)** A difference in origin in the behavioral syndrome was not detected (Fig 2), although origin influenced variation in individual behaviors

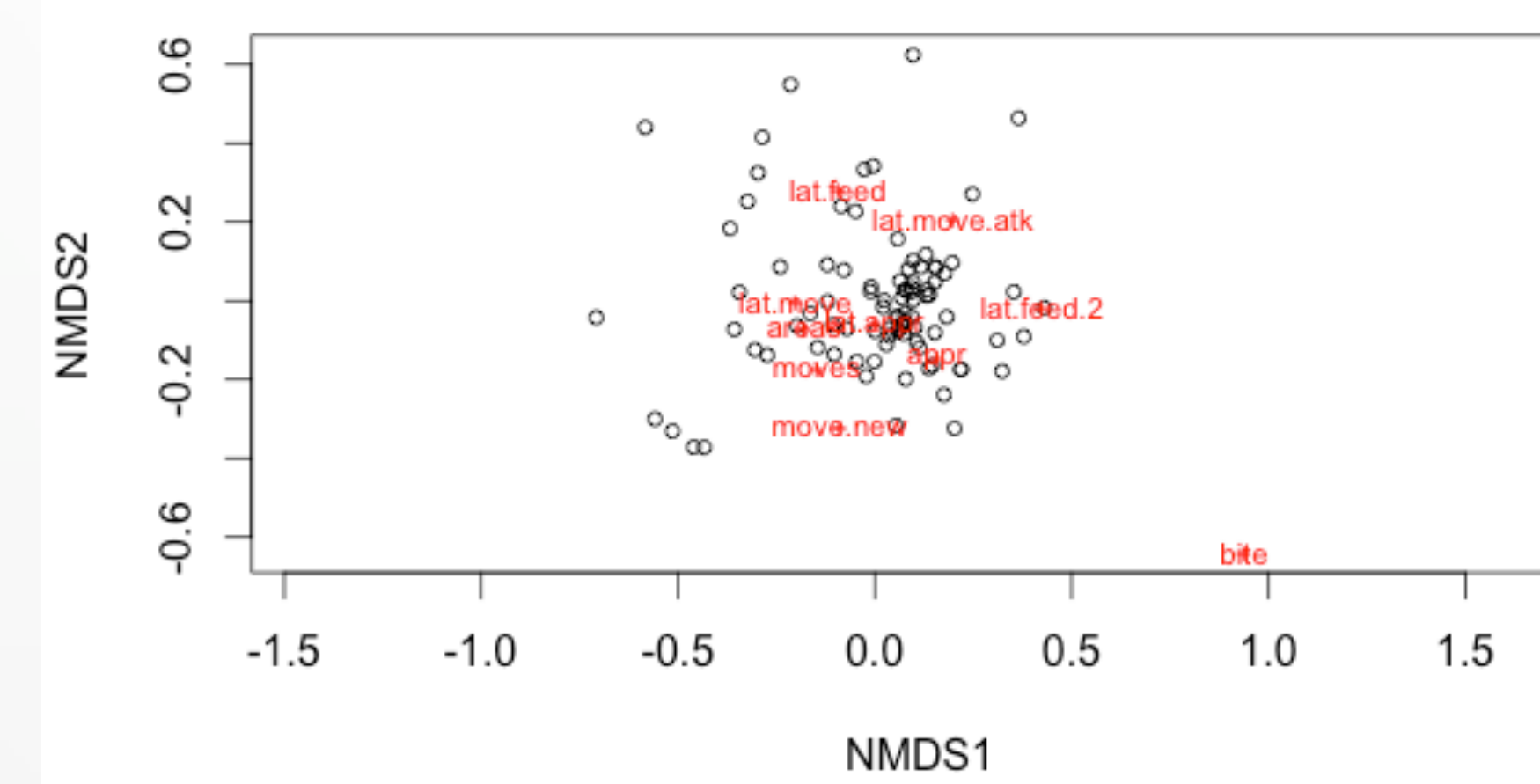


Figure 1. NMDS plot illustrating directions of behavior.

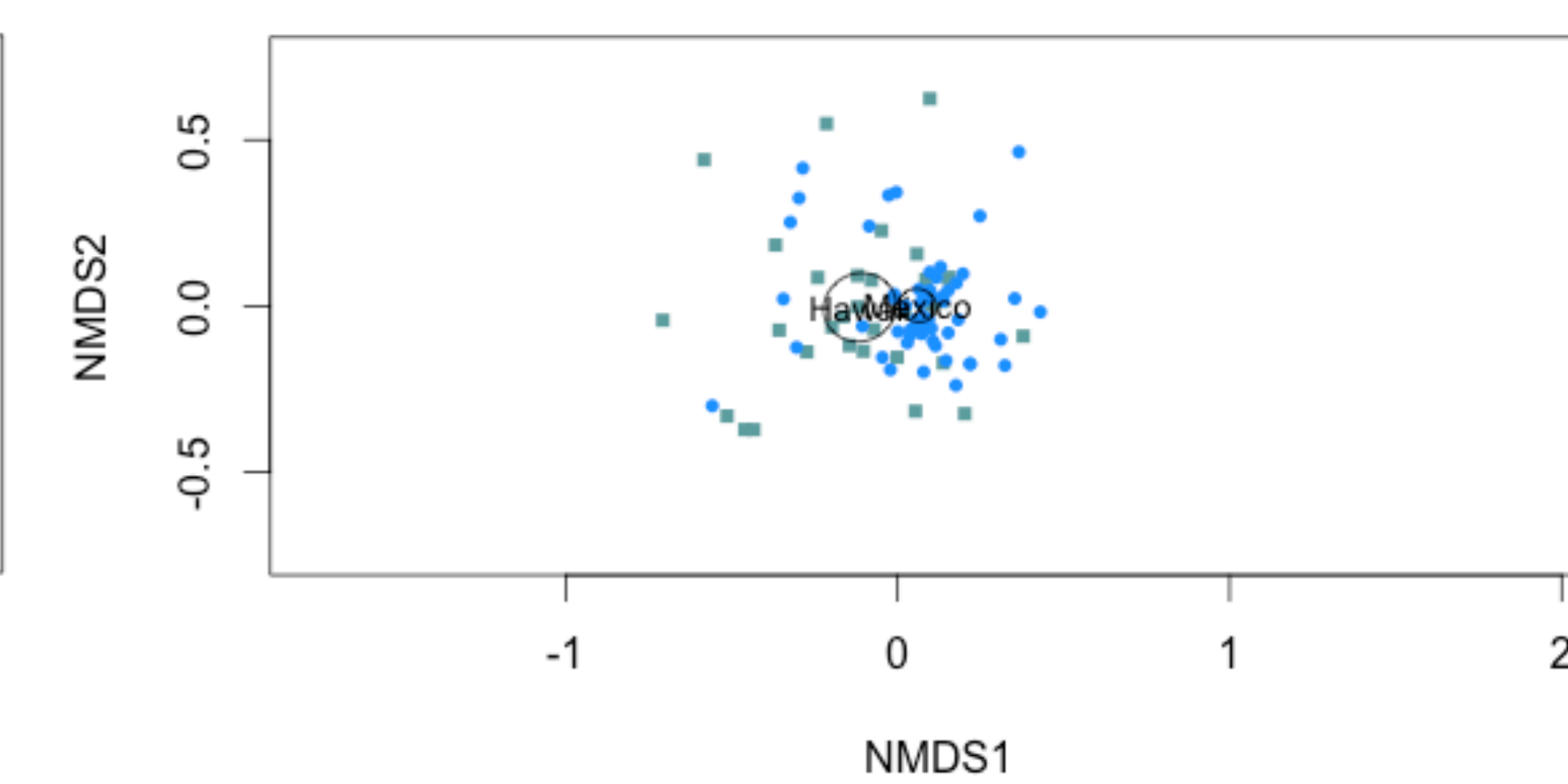


Figure 2. Behavior as indicated by origin.

Table 1. Repeatability Measures

Behavior	Category	ICC
Latency to Move	Exploration	0.621
Movements	Exploration	0.467
Areas	Exploration	0.555
Latency to Approach	Aggression	0.481
Approaches	Aggression	0.651
Feed Time	Boldness	< 0.001
Emergence	Boldness	0.144



- The measures of exploratory and aggression were 'highly' repeatable (>0.4), while boldness measures were not repeatable (Table 1).
- Variation in exploration was explained by both aggression including origin*sex (p<.001) boldness including origin*sex (p<.001).
- Variation in aggression was explained by both exploration including origin and sex (p<.001) and boldness including sex (p<.001).
- Variation in boldness was explained by exploration including origin*sex (p<.001) and aggression including origin*sex (p<.001).

Discussion

- A behavioral syndrome (exploration-aggression-boldness) was detected in both populations and sexes. There was also an interaction detected between sex and origin influencing variation in some of the behaviors.
- Difference in exploratory behavior by sex reflects high dispersal in female livebearers (5).
- Two possible reasons for detecting similar behavioral syndrome in invasive population (Hawaii) and native population: 1) hybridization has not changed behavioral response 2) reduced variation not issue due to large broods of livebearers.
- Future directions include: further statistical analyses to tease relationships apart, study of heritability of behaviours between populations, and studying behaviors of line bred fish.

References

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